DOCUMENT RESUME

ED 103 228 SE 018 320

AUTHOR Bromley, Albert W.
TITLE Save Our Water Resources.
INSTITUTION Boy Scouts of America, New Brunswick, N.J.
PUB DATE 73
NOTE 32p.

EDRS PRICE MF-$0.76 HC-$1.95 PLUS POSTAGE
DESCRIPTORS Biological Sciences; Conservation Education; Ecology; Environment; Environmental Education; *Instructional Materials; Learning Activities; *Natural Resources; Outdoor Education; Pollution; Science Education; Secondary Grades; *Student Projects; *Water Pollution Control; *Water Resources
IDENTIFIERS Project SOAR

ABSTRACT

The purpose of this booklet, developed as part of Project SOAR (Save Our American Resources), is to give Scout leaders some facts about the world's resources, the sources of water pollution, and how people can help in obtaining solutions. Among the topics discussed are the world's water resources, the water cycle, water quality, sources of water pollution, the need for oxygen, and types of water pollution (such as siltation, sewage, organic wastes, plant nutrients, mineral substances and salts, radioactive substances, and thermal pollution). Methods of preserving our water resources for the future are discussed. Learning objectives for water quality projects, water supply projects, and water conservation projects are included. A list of student projects relating to water quality, marine waters, fish biology, and fish conservation is appended. (BT)

ED103228

U.S. DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

BEST COPY AVAILABLE

BEST COPY AVAILABLE

BOY SCOUTS OF AMERICA

SAVE OUR WATER RESOURCES

PERMISSION TO REPRODUCE THIS COPYRIGHTED MATERIAL HAS BEEN GRANTED BY
Alden G. Barber
Boy Scouts of America
TO ERIC AND ORGANIZATIONS OPERATING UNDER AGREEMENTS WITH THE NATIONAL INSTITUTE OF EDUCATION. FURTHER REPRODUCTION OUTSIDE THE ERIC SYSTEM REQUIRES PERMISSION OF THE COPYRIGHT OWNER.

SE018 320

SAVE OUR WATER RESOURCES

Albert W. Bromley
Director (Ret.), Conservation Education
New York State Department
of
Environmental Conservation

Copyright 1973 by Boy Scouts of America Printed in U.S.A.

SAVE OUR WATER RESOURCES 2

OBJECTIVES 3

A LOOK AT THE WORLD'S WATER RESOURCES 4

WATER QUALITY 7

NEED FOR OXYGEN 10

TYPES OF WATER POLLUTION 10

WHAT ABOUT THE FUTURE? 16

WHAT YOU CAN DO 19

SAVE OUR WATER RESOURCES

Water is one of our most important natural resources. But until recently, little thought by the general public was given to our dependence on this basic natural commodity.

However, the volume of pollutants brought about by our expanding population and economy is increasing rapidly. We must think and act more intelligently about our water resources than ever before. More and better water pollution abatement methods will be required in the future.

The purpose of this booklet is to give Scout leaders some facts about the world's resources, the sources of water pollution, and how people can help in obtaining solutions. It will also provide practical project ideas for Scouts.

The aim of Project SOAR (Save Our American Resources) is to involve Scouts in relevant activities that will have specific and measurable positive effects on our American resources – – in this case, water resources.

In the process, the Scout leader should find ways to impart a number of important learning experiences that will enable these young men to appreciate and care for our threatened waters.

BEST COPY AVAILABLE

OBJECTIVES

Among the major learning objectives of this program are:

Water Supply and Conservation

1. Learn to recognize and appreciate the importance of water as a natural resource -- not just to drink, or flush away our wastes, or to use in industry or agriculture -- but the importance of water in the ecosystem.
2. Gain an understanding of local water supply problems, needs, available supplies, and treatment facilities.
3. Find out how moisture moves in a cycle from atmosphere to earth and back again -- how man's needs are within this cycle -- the consequences of man's use of water.
4. Gain an understanding of the watershed management concept, relating good conservation practices on the upland to good fishing in the streams and lakes down the hill from a well-managed watershed.

Water Quality

1. Learn how siltation and pollution affect recreational opportunities -- fishing, boating, swimming.
2. Learn about the treatment of wastes -- human, agricultural, and industrial -- as a challenge in maintaining suitable water quality.
3. Learn elementary fish biology -- from how a fish lives to habitat requirements for different species.
4. Gain an understanding of how bodies of water age (eutrophication).
5. Learn about Federal, state, and local laws controlling pollution and who is responsible for enforcement.
6. Learn something about the cost of water pollution control and the cost of cleaning up our waterways. Learn something about the problem of who pays these costs.
7. Find out what constitutes good outdoor manners and good sportsmanship related to fishing, boating, and other water oriented activities.

Marine Waters

1. Learn the special importance of estuaries (areas along the seacoasts where fresh and salt waters mix).

These are only some of the learning objectives for boys – and for many adults, as well.

A LOOK AT THE WORLD'S WATER RESOURCES

Only three per cent of the world's water is fresh, and much of that is ice and snow at the polar caps. About one-half of one per cent of all water is in fresh water lakes, ponds, streams, rivers, and under the ground. The total quantity is still so great that our forefathers never dreamed there could be water shortages, except in desert regions.

And here lies the root of our water problems. Water isn't always where it's needed, and through the years the practice of freely using water has developed where it is readily available. Not enough consideration has been given to development of adequate cleaning of our effluents (discharges).

We consume or in some way degrade 350 billion gallons of water each day in the U.S. Industry uses a total of 177 billion gallons per day, most of it for processing and cooling. Agriculture uses about 145 billion gallons per day for irrigation of crops. In our homes, for all domestic needs, we use 16 billion gallons each day, and the remainder is used in rural areas.

The public water supply system provides running water at our fingertips. Every individual uses from 60 to 70 gallons every day; the average family uses from 250 to 300 gallons per day. Consider the many ways water is used in the home: flush toilets (3 gallons per flush); automatic dishwashers (10 to 15 gallons per wash); automatic clothes washers (20 to 30 gallons per wash); bath tubs (30 to 40 gallons per scrub); and showers (20 to 30 gallons per shower); plus water for drinking, cooking, hand and face washing, window and floor cleaning, car washing.

BEST COPY AVAILABLE

All industrial and agricultural as well as home uses of water change and lower the quality of the water in some way. We will discuss these changes and the problems they create later.

Recreation is an important use of water that cannot be overlooked. Millions of people have fun in and on water every day. Each year some 100 million Americans go swimming, 57 million go fishing, 52 million use motor boats, 6 million paddle canoes, and 5 million sail sailboats. By the year 2000, these numbers are expected to increase by 190 per cent. We all have a huge stake in preserving our water resources and leading the action to protect them from waste and pollution.

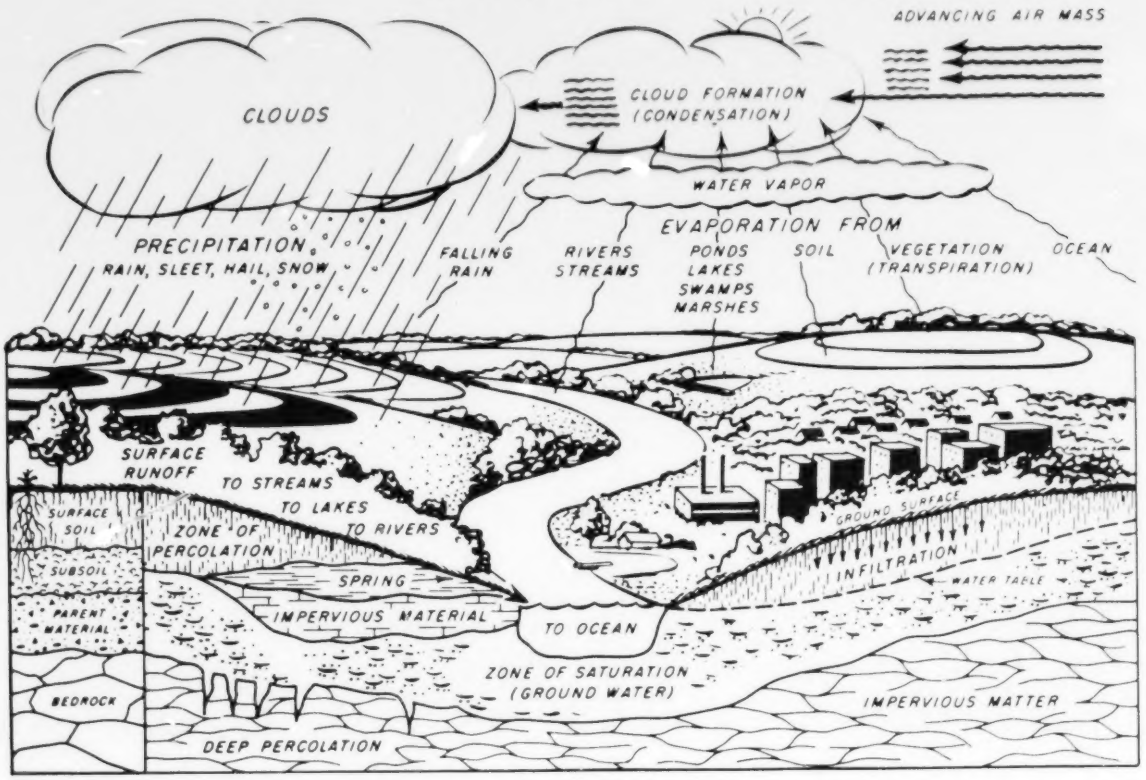
In some situations, particularly in the western U.S., the availability of water and the quality of water determine whether life can be sustained in an area. In most situations, water can be used by man a number of times.

As an ultimate example, there are now places that use advanced sewage treatment and water purification systems that actually turn sewage into drinkable water. Triple (tertiary) treatment is used, and it's expensive. But this will have to be done in more places in the future.

A lot more common and practical method is for cities and towns and all industrial water users to provide adequate systems to remove the majority of wastes and all dangerous pollutants before waste water is returned to the nearby river or lake. Natural processes of self-purification will do the rest of the cleanup job. Unfortunately, we are a long way from that point now. Not all users of water are adequately cleaning their wastes before returning them to the nearest body of water.

Rapidly increasing population and industrial and agricultural production are going to exert more and more pressure on water supplies. At the same time, the quality of those supplies is being destroyed by expanding volumes of pollutants, so we must carefully and responsibly use and protect our water resources. We must be aware of the many problems of water pollution and how we can do our share in helping to solve the problems.

BEST COPY AVAILABLE



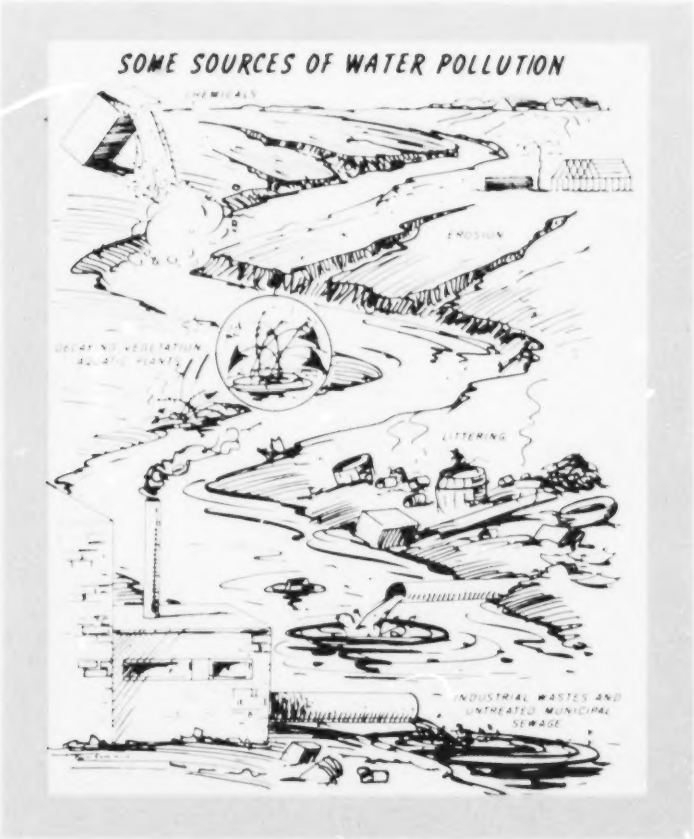
WATER QUALITY

The record in this country of using and abusing, exploiting and degrading, exhausting and discarding our natural resources is unequalled in history. And of all our crimes against nature, we have damaged the quality of our water resources the most.

We have accomplished massive degradation by loading our rivers, streams, lakes, and reservoirs, with silt and soil eroded from the land, by pouring raw sewage and organic wastes from our cities and towns into the handiest streams and rivers, and by filling our surface waters with organic fertilizers washed from the land. We have spread infectious disease organisms, allowed the poisoning of waters and the living creatures therein with organic chemicals, permitted deadly salts and mineral substances to drain into surface waters, and exposed waters to radioactive wastes. And now, we are endangering the balance of life in water by adding heat (thermal pollution).

Water resource scientists are not exaggerating when they say, "Water pollution is recognized as one of the most vexing problems facing the American people. Civilizations have withered and died because of the loss of usable water. The trend must be reversed or, as both history and logic tell us, we face disastrous consequences."

To understand the grim meaning of that prophecy, we will look more closely at several types of water pollution and their sources. The ways to fight and overcome these problems will become clearer also.



Sources of Water Pollution

The chief sources of pollution can be identified as municipal, industrial, and agricultural.

Municipal Pollution — Over the past 20 years, the nation has invested about $15 billion in the construction of some 7,500 municipal sewage treatment plants, sewer systems, and related facilities. Yet, some 1,400 municipalities, including some fair-sized cities, still dump untreated or poorly treated sewage into the nearest waters. More than 300,000 factories put their industrial wastes into municipal systems not equipped to process many of the complex industrial pollutants of today.

BEST COPY AVAILABLE

The combined sanitary and storm water sewers (one pipe carries both) in some 1,500 cities – mostly older and larger municipalities – are another major contributor to municipal water pollution. When such a combined system is overburdened by a heavy rainfall, the local treatment plant simply cannot handle the volume, and the combined raw sewage and storm water runoff are discharged without any treatment at all.

Industrial Pollution – The most distressing aspects of industrial pollution are their complexity and increasing volume. Industry rapidly produces complex pollutants faster than scientists and engineers are developing and implementing methods to neutralize them.

Pollution from organic industrial wastes is now the equivalent of pollution produced by 210 million people.

Heated water from industrial cooling presents a special technological challenge. At higher temperatures, water cannot hold enough oxygen to decompose certain organic substances or support fish and plant life.

Other forms of industrial pollution include oil spills, emission of harmful chemicals, acid mine drainage, and dredging.

Agricultural Pollution – The two main sources of agricultural pollution are animal wastes and the use of pesticides, herbicides, and synthetic fertilizer.

In recent years, the cattle feedlot has become the center for mass production of beef. The result is a large concentration of significant wastes in a small area. One steer produces pollution equivalent to that of 17 humans – a nationwide sanitation problem equivalent to that of almost a *billion people*.

Miscellaneous – Watercraft provide another serious source of human waste polluting harbors, rivers, lakes and other waters. There are approximately 46,000 Federally registered commercial vessels, 65,000 unregistered commercial fishing vessels, and some 8 million recreational craft. Too few are equipped with effective sewage treatment devices.

NEED FOR OXYGEN

The life of any body of water depends mainly upon its ability to maintain a certain amount of oxygen, which fish and all other aquatic animals need to live. But organic wastes consume oxygen from water when they decompose. When the sewage load (organic waste) in a waterway is excessive, the demand for dissolved oxygen exceeds the available supply. The sewage decays, and the water begins to give off bad odors. Carried to the extreme, the water could lose all its oxygen, resulting in the death of fish, other animals, and beneficial plant life.

Large quantities of oxygen-demanding pollutants, including domestic sewage and industrial wastes, have been dumped into Lake Erie, and little oxygen is available in the water over extensive areas. While not a "dead lake," Lake Erie is certainly in bad shape.

An index of the amount of oxygen required for biological oxidation of organic matter in a liquid is called biochemical demand, or BOD for short. When organic pollution is heavy, the BOD is high, showing that there is not enough dissolved oxygen to support fish and plants.

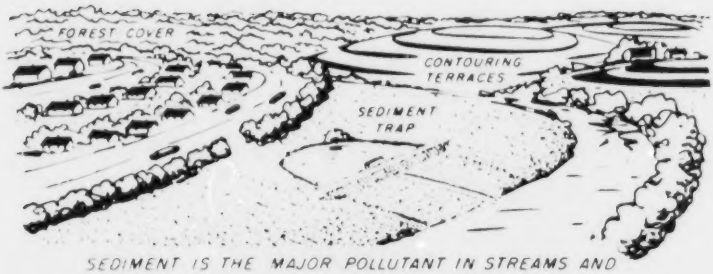
Tests of available oxygen in a waterway can be made to determine the amount of organic pollution present. Such tests are used regularly to determine how well a sewage treatment plant is operating.

TYPES OF WATER POLLUTION

Siltation -- One of the simplest and most common forms of water pollution is siltation. It is also by far the oldest. Runoff from farm land, construction projects, strip-mined land, and eroded streambanks carries sediment into our waterways.

The problem is keeping the productive soils where they can continue to produce without them being lost to streams, rivers, and the sea by soil erosion. Not only is good top soil lost in this manner, but the delicate relationships of aquatic plants and animals are harmed when loads of silt are dumped on them and thus rob them of light and oxygen.

BEST COPY AVAILABLE



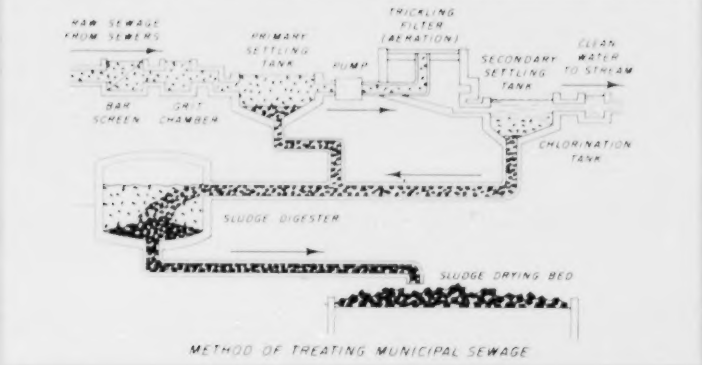
SEDIMENT IS THE MAJOR POLLUTANT IN STREAMS AND RIVERS. PROPER LAND TREATMENT GREATLY REDUCES THE AMOUNT OF SEDIMENT ENTERING STREAMS.

The earth can be protected from erosion, and this form of water pollution can be reduced by greater use of sound soil conservation practices. Great strides have been made, but much more remains to be done.

More than 500 million tons of soil from the fertile great plains area of the U.S. are washed down the Mississippi River into the Gulf of Mexico every year. The Mississippi may be our dirtiest river in terms of sediment load, but it's not the only one.

Sewage and Organic Wastes -- The pioneers dumped their sewage into the handiest streams because it was the easiest thing to do. Years ago, the process of natural self-purification by the river itself took care of such small volumes of pollutants. Moreover, nobody was downstream to suffer. But circumstances and populations have changed. More and more people are now "downstream" to suffer the consequences of upstream domestic sewage and the organic wastes of such industrial operations as food processing, meat packing, paper production, and leather tanning.

Oxygen-demanding organic pollutants pose a serious threat to the very life of our waterways. When these substances consume the available oxygen as they decompose, the delicate balance of life is upset. Fish die when the contamination is too gross, and the quality of the lake or stream is seriously damaged or destroyed.



METHOD OF TREATING MUNICIPAL SEWAGE

The technology is available so that all state and Federal standards for treatment of sewage and organic wastes can be met. But waste treatment plants are expensive to build and operate, and they add little to the intrinsic value of the community or plant that builds one. Still, concern for our fellow men "downstream" and concern for our natural resources which belong to all Americans dictates that citizens work diligently to assure the passage of referendums and bond issues that will bring better sewage treatment to their communities.

Plant Nutrients -- Such elements as nitrogen, potassium, and phosphorous are foods that plants must have to live and grow. However, while enough of these nutrients is essential, too much can be fatal. And too much is what our waters have been getting in recent years.

Part of this problem arises because of the greater use of phosphate and nitrate fertilizers in agriculture to increase crop production and on lawns to stimulate growth. Trouble is, the crops and grasses don't consume all of the nutrients, and the surplus either washes off the land directly into streams, rivers, and lakes, or it seeps into the ground water supply only to appear later in surface waters.

Perhaps equally important in the over-fertilization of some of our waters has been the widespread use of household

BEST COPY AVAILABLE

detergents to which phosphorous has been added as a cleansing agent.

In recent years, an estimated one billion pounds of phosphorous and five billion pounds of nitrogen have been added each year to U.S. waters.

It takes only tiny amounts of phosphorous and nitrogen in solution to greatly increase the growth of water plants. When over-fertilized, the shallow waters of lakes and ponds become choked with water weeds, and the surface waters are blanketed with scums of tiny floating algae, which in turn reduce the oxygen supply in the water.

Sometimes during the warm summer months, some lakes become so loaded with tiny algae one cannot see through the water. When this happens, fishermen say the lakes are "working." Engineers and scientists identify such over-enriched lakes as "eutrophic."

It is a way of calling a lake old before its time. Lakes normally age very slowly, changing over a long period from cold, clear bodies of water supporting such fish as salmon and trout to warmer, murkier, weedier waters where fish like carp and catfish live.

The eastern basin of Lake Erie is eutrophic. Without man, this aging process in Lake Erie would have taken some 15,000 years.

Organic Chemicals – Man has been using a great variety and quantity of chemical products for many years to kill weeds and insects all around the world. Weed killers (herbicides), rodent killers (rodenticides), and insect killers (insecticides) have been widely used in agriculture to increase crop production and by government agencies and individuals to eradicate pests.

The most serious problems with such chemical products are that some effects do not always appear for a long time, and sometimes their poisonous qualities are also long-lasting.

Millions of pounds of these chemicals are used all over the world. They seep into the soil and are carried into our streams, rivers, lakes, and ultimately into the oceans.

The long life of these poisons sometimes leads to chain-reactions. Tiny micro-organisms, which form the base food supplies in lakes, pick up chemicals sprayed in the area for insect and weed control. Larger and larger forms of life accumulate the poison in their systems as they consume the smaller forms. Levels build up in the bodies of the larger fish until they can no longer stand the contamination, and they die.

The same thing happens with other creatures where the larger ones eat the smaller until they get to the top of the food chain, sometimes pictured as a pyramid. Some large predatory birds are in serious trouble on their pyramid tops because of pesticide build-ups in their food chains. The numbers of eagle, falcon, osprey, and pelican are dwindling, and in parts of their former ranges they have disappeared completely.

Mineral Substances and Salts -- Pollution by some mineral substances and salts has been recognized only recently. Included in these substances is drainage from both surface and underground mines. Mine drainage is strongly acid and very destructive to aquatic plants and animal life. The U.S. Bureau of Mines estimates that in one Appalachian state 360 million gallons of acid mine waste drain into streams every day. Widespread fish kills have resulted.

Also in this group of pollutants are salt brines discharged in the course of various industrial processes and by agriculture.

The mineral substance of greatest concern is mercury, a heavy metal used in a variety of industrial processes and by agriculture. More than 80 industries use mercury in manufacturing, discharging wastes into waterways. Until recently eighty per cent of all seed sold commercially in this country was treated with mercury compounds to combat various blights and fungus diseases. Mercury in this form is carried into ground water supplies and eventually into surface waters.

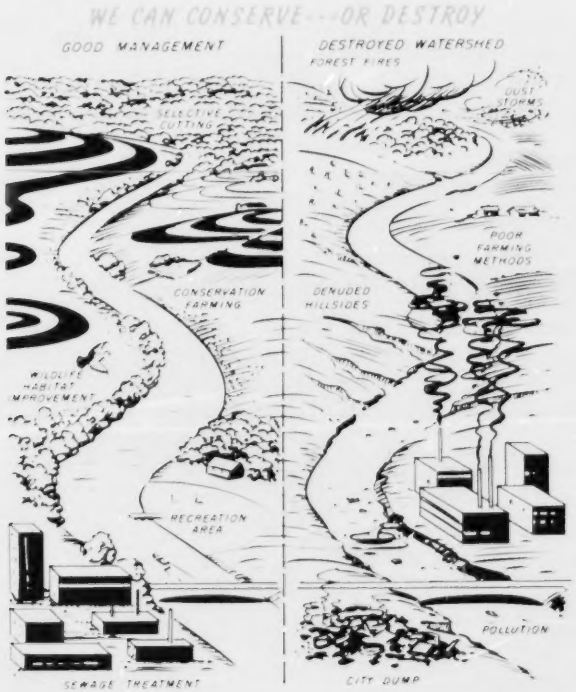
The discharge of mercury into the Great Lakes exceeds 500,000 pounds per year. This didn't appear to concern

BEST COPY AVAILABLE

anybody until 1970, when Canadian scientists found mercury levels in fish taken commercially from Great Lakes waters were too high for human consumption. The waters were closed to commercial fishing. New York State has banned the sale of fish high in mercury content and closed some lakes to all fishing.

Steps have been taken to reduce the amount of mercury being discharged into these waters, but no one knows as yet how to get rid of mercury already there. Elsewhere in the world, mercury poisoning has taken its toll in human lives, in Japan and Iraq to be specific.

Radioactive Substances – Another potential source of pollution is the disposal of radioactive wastes. Great care must be taken or the ocean depths and our deep ground water supplies could become contaminated.



Thermal Pollution — The discharge of great quantities of heated water into rivers, lakes, and the sea is called thermal pollution. Pouring hot water into our waterways is not new in itself. Industry has been doing that for years, but in relatively small quantities. Only recently has this become a serious problem because of the development of nuclear electric power generating plants. In the process of generating needed power, tremendous amounts of heat are transferred into water used for cooling the reactors and other equipment.

Albert C. Jensen, a marine biologist employed by the N.Y. State Department of Environmental Conservation, reported that 11 existing and planned fossil-fuel and thermonuclear power generating plants along the shores of Long Island Sound would, when all are in operation, discharge at least 7.2 million gallons of heated water *per minute* into the Sound. That is a million gallons per minute more water than flows over the American side of Niagara Falls. And this huge volume of water would be 20 to 30° hotter than the normal temperature of the Sound.

The estuarine (mixture of fresh and salt waters) area of Long Island Sound is the nursery and home of all kinds of microscopic aquatic life (called plankton) that support a commercial and sport fishery valued at more than $24 million per year. This marine life is so delicately balanced that release of heated water in such volume could destroy it.

Engineers have a number of ways to control thermal pollution. Cooling towers can dissipate heat by evaporation. Hot water may be spread over the water or discharged from several outlets. Artificial lakes may be created to cool heated water and provide recreation or esthetic attractions as well.

WHAT ABOUT THE FUTURE?

Putting a halt to the gross pollution of our water resources is a matter of survival for all of us. There are encouraging signs that the public, industry, and government are awakening to the water crisis we face. The Federal

BEST COPY AVAILABLE

government has acted to pass more effective laws against water polluters, and it is enforcing these stricter codes more vigorously. In addition, millions of dollars have been made available in both Federal and state funds to aid cities, towns, and villages to install modern sewage disposal plants and to modernize old ones not doing the job properly. Many states have surveyed their total water supply and water use needs, establishing water purity standards on whole watershed bases.

The U.S. Soil Conservation Service has an on-going program to reduce water run-off and soil erosion. Similar work is being done by the Bureau of Reclamation on publicly owned lands, especially in the western states, to develop small check dams and reservoirs to hold back and regulate high spring run-off and flash floods.

Action has been taken to reduce the amount of phosphorous used in synthetic detergents, thereby slowing to some degree at least the over-fertilization of our surface waters. Many states have taken action to regulate the manufacture and sale of persistent and poisonous pesticides.

In mining states, closer inspections are being made and tougher regulations being enforced to reduce the discharge of acid wastes into the waterways.

Stricter safety and oil spill precautions are in effect governing drilling and oil well operations along the continental shelf and coastal estuaries.

Industry is much more aware of water pollution hazards than in the past. Many big petroleum companies, for example, take special care not to pollute coastal waters or harm beaches and estuaries. Almost every company's annual report tells of concern for and efforts to preserve the environment.

These things are happening because the public is awakening to the water pollution problems they face. Individuals are speaking out about the abuses they see. Citizens groups are pushing hard for better protective laws against pollution and for more effective government programs to clean up our waters.

BEST COPY AVAILABLE

People can and will work to bring pollution abuses to a halt if they understand the problems. They will vote for stricter anti-pollution laws, and they will even vote to pay more taxes to provide the necessary funds to control pollution.

The keys to this kind of action are public understanding and awareness.

WE SOMETIMES DAMAGE WILDLIFE HABITAT

WHAT YOU CAN DO

Scout groups can do a great deal to get local action started. One of the best ways is to be well informed about local water pollution situations -- the problems and the proposed solutions.

An excellent person to contact first is the civil engineer in your town. His technical and professional training has made him an expert in sanitary engineering. You can contact him through the Engineering Department of your city or town.

Then, take your information to the public in the form of talks and illustrated programs, newspaper and TV publicity, posters, clean-up projects, displays, fairs and other activities.

First, the troop or patrol should learn as much as possible about the main sources of water pollution, the primary pollutants, and the effects of pollution. Then, take some good hard looks at conditions in the local community. Set up a water resources task force as the local SOAR project.

Following are some action ideas for your task force. Don't forget the importance of pictures, both black and white and color slides. They will be the evidence you will rely on when it comes time to tell your story to the public.

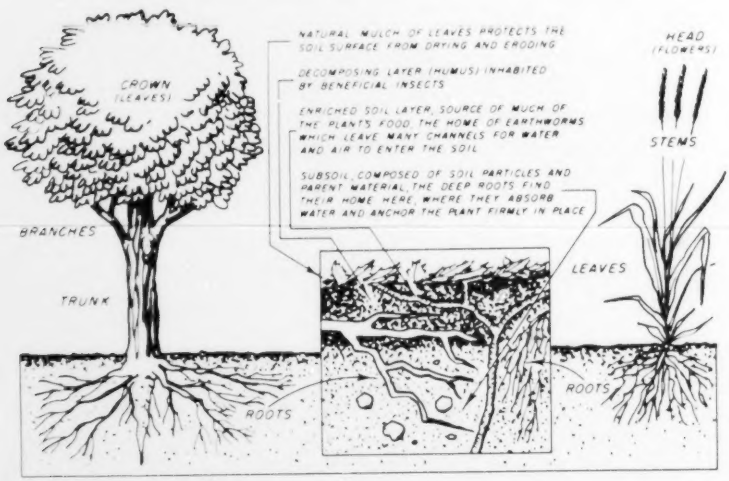
Water Conservation Projects

1. Prevent and stop stream bank erosion by planting the banks with grasses, legumes, shrubs, or trees where applicable and recommended.
2. Where a stream is actively undercutting and causing bank erosion, rip-rap the stream bank with rock or logs.
3. Under supervision, construct structures such as deflector dams, V-dams, or other devices to improve the stream as a fisheries resource and/or to control flow.
4. Build retaining walls or rip-rap to stop or prevent wind or wave erosion.
5. Rip-rap dam spillways and/or ends of dams to prevent erosion.

6. Co-operate in a watershed study and improvement project.
7. Determine how much water your family uses each day, month, year.
8. Check your home for water loss and corrective measures:

   - dripping faucets (inside and out)
   - shower vs. bath (shorter showers)
   - container of water in refrigerator
   - container to rinse dishes
   - accumulate dishes to wash
   - plug in sink to wash hands
   - full load in clothes washer
   - water garden in late afternoon
   - mulch garden
   - reduce toilet flush volume

9. Plant bare and/or gullied areas to prevent or stop soil erosion and siltation of waterways.


NATURAL MULCH OF LEAVES PROTECTS THE SOIL SURFACE FROM DRYING AND ERODING
DECOMPOSING LAYER (HUMUS) INHABITED BY BENEFICIAL INSECTS
ENRICHED SOIL LAYER, SOURCE OF MUCH OF THE PLANTS FOOD, THE HOME OF EARTHWORMS WHICH LEAVE MANY CHANNELS FOR WATER AND AIR TO ENTER THE SOIL
SUBSOIL, COMPOSED OF SOIL PARTICLES AND PARENT MATERIAL, THE DEEP ROOTS FIND THEIR HOME HERE, WHERE THEY ABSORB WATER AND ANCHOR THE PLANT FIRMLY IN PLACE
CROWN (LEAVES)
BRANCHES
TRUNK
ROOTS
HEAD (FLOWERS)
STEMS
LEAVES
ROOTS

PLANTS AND THE SOIL

BEST COPY AVAILABLE

Water Quality Projects

1. Find out what sort of sewer systems your area has. Does it have separate storm and sanitary sewers? Or are they combined sewers? If so, what happens during a heavy rainstorm? Does the sewage treatment plant have the capacity to treat storm water runoff?
2. Visit local sewage treatment plant. Ask the civil engineer in charge about its operation. Where does the water go when it leaves the plant? What happens to waste material taken from water? What is the efficiency of treatment?
3. Visit the public agency in your community responsible for sewage treatment. Ask questions. Find out from the chemists and sanitary engineers just how it works. Ask them what their problems are. See if the system is old and out of date, or if it provides primary and secondary treatment, or more.
4. Test acidity of stream or pond with an inexpensive water pH kit. Find out what a normal pH reading should be for that water. Show relationship of water acidity to kinds of fish or lack of fish and other animals.
5. Test a stream for BOD, if possible, to determine the amount of organic pollution present. Make tests over a period of time, including dry summer months and immediately following heavy rains. Make charts of readings.
6. By sampling stream after rain, determine amount of soil loss over a period of time in that particular watershed.
7. Determine what industries in your area are using water. Are they adding pollutants such as chemicals, acids, metals, or other wastes to the water they use? If so, where does this water go? Do the industries treat it themselves? Is it piped to the local sewage treatment plant?
8. What about the lakes in your area? Are the shores clean and unlittered? Are the shallow waters choked with algae and vegetation? Are there game fish to be caught?

9. What kind of water-based recreational opportunities are there in the area? Are there clean beaches and waters where people can swim? Are they good for fishing? Or do waters and water-front areas where pollutants, littering, and threats to public health and safety make recreation impossible? Could these areas be cleaned up?
10. Clean up a section of a lake or stream by removing unsightly rubbish. Get the newspaper or local TV station to publicize the project.
11. Demonstrate hydrologic cycle with emphasis on "normal" runoff, floods, low water in streams, storm sewer runoff, over-use of ground water supplies.
12. Make or buy litter bags for distribution to boat owners.
13. Sponsor a poster or photo contest on the subject of water pollution and conservation.
14. Have a water resources camporee with activities centered around the use of water for swimming, boating, fishing; displays, and projects.

Marine Waters Project

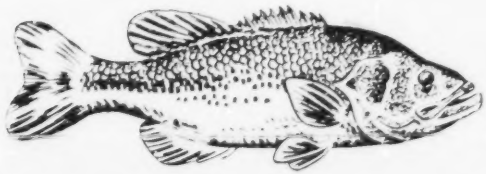
If you live near the sea shore or the mouth of a river flowing into the ocean, find out what is going on in these estuarine waters and wetlands. Are they being used as garbage dumps, or are they unspoiled and producing a great variety of plant and animal life?

Fish Biology Projects

1. Set up an aquarium using aquatic animals (fish, insects, etc.) and demonstrate with chemicals how water pollution can:
   (a) directly kill organisms, (b) remove oxygen and kill organisms. Do the same with heat.
2. Make a study of aquatic organisms: fish, reptiles, amphibians, insects, snails, worms, leeches, crustaceans. Develop food chains for that paricular pond or stream. Include mammals, birds, and man that utilize those organisms at the top of the chain.

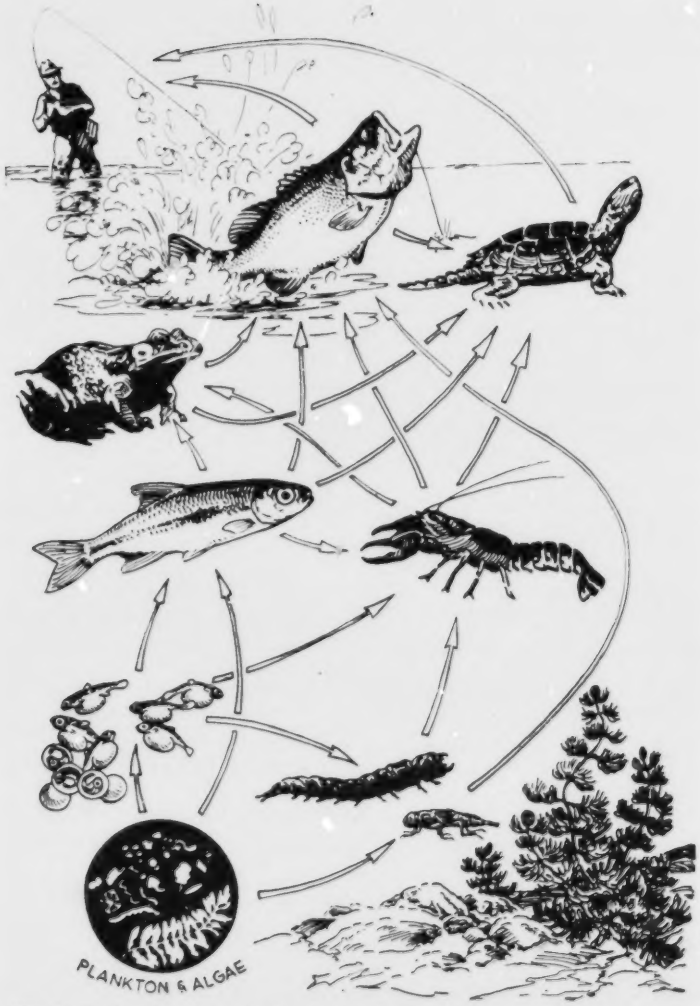
BEST COPY AVAILABLE

3. Upon recommendations of a biologist:
   - build and anchor brushpiles for fish in lake or pond
   - place cover devices in stream for fish
   - plant shrubs/trees along stream for shade
   - build and place gravel nest boxes for trout
   - fertilize pond
4. Demonstrate the Sport Fishing Institute Conservation Chart #3810 to the troop.
5. Learn how to age fish (sunfish variety) and determine from known ages and sizes of some species for that locale, condition, which are normal or stunted.
6. Learn internal and external anatomy of a fish. Understand the mechanism of how fishes respire, importance of water quality, indicator fish, and other factors.



Fish Conservation Projects

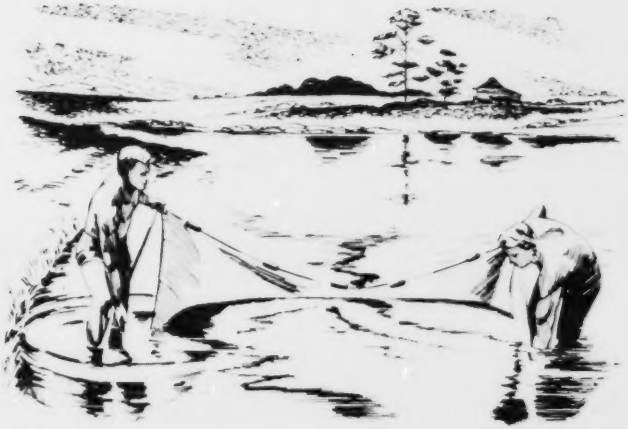
1. Learn the names of the different kinds of fish which are caught in your vicinity. Then read about the life-history of these species. You will find that different fish have different habits. Some prefer cold water and some want warm water. Some are found mainly in fast streams, others in slow-moving streams or lakes. Some prefer the shallow water along the edge of a lake, others may remain in deep water. The shape of a fish will often tell you something about its habits. For example, a fish normally living in fast water will be streamlined in shape.



The bass that is so much fun to catch depends upon plankton and algae for its food. Here you can trace a food chain from tiny plants and animals to a large-mouth bass.

BEST COPY AVAILABLE

2. Examine the stomach of the fish you catch to see what they have been eating.
3. Keep a record of your fishing trips. Put down the number of hours you fished and the dates, time of day, number, size, and kind of fish caught, the baits used, weather conditions, and any other items which come to mind. If you keep a fairly complete fishing record and examine it once in a while, you may be able to learn why you did better some trips than on others. Your fishing might improve as a result of such a project.
4. If you have a strong light, you might want to walk or paddle along the shallow water to see what fish are on the shoals at night. Some species which are in deep water by day tend to move into the shallows at night.
5. Find out when fish lay their eggs and examine a bass or sunfish nest. The male bass and sunfish build a circular saucer-shaped nest on the bottom in water from one to six feet or more in depth. These males also guard the eggs and young in the nest. If you happen to have kept a fish with eggs in it, try to count the eggs. If the fish is a trout,you may find only a few hundred. If it's a big carp, you will probably tire of the job long before you have counted half the eggs.
6. Try using all four main types of tackle -- casting, spinning, spin-casting, and fly fishing equipment.
7. If a microscope is available, take the scales from some fish, clean them thoroughly to remove the dirt and slime, and examine them. Fisheries workers can tell the age of fish by examining the scales. It's a little like telling the age of a tree by counting the rings, though it isn't that easy.
8. If you fish extensively in one fairly small stream or lake, take along a pair of shears and do some fin-clipping. Simply remove one of the paired fins by clipping it off with the shears. It should be cut right at the base. Fish aren't nearly as sensitive as we are, or as dogs and cats



are, and losing a fin doesn't bother a fish to any extent. By fin-clipping and carefully returning a known number of the fish to the water, you can get a rough idea of the number of fish present. For example, if ten per cent of the fish caught within the next few months are fin-clipped fish, there are roughly ten times as many fish as you marked. The method isn't exact, but when properly done, it will tell you whether most of the fish are being caught, or whether the anglers are taking only a small percentage of them.

Fish research men also use small numbered tags. When you use these you can learn something about the distance travelled by the fish. If some are retaken many miles downstream or upstream, you know that the fish migrate extensively. You might be able to get some tags from your local fish department.

9. If you have a high-power microscope, examine a sample of water from a lake or stream. You may be able to see some of the microscopic plants and animals which are so important as food for insects or for small fish.
10. Check the water temperature from time to time with a thermometer. Some fish, such as trout, prefer cold water; others, like a smallmouth bass, prefer cool waters. The largemouth bass and some other species thrive best in warm water. Fish are cold-blooded. They need very

BEST COPY AVAILABLE

little food in winter. As the water gets warmer, the fish get more energetic and use more food provided, of course, that the water doesn't get too warm. Since fish are influenced quite a bit by water temperature, keeping a record of the temperatures each time you go fishing might be helpful to you in your angling. For example, the big fish may be in deep water in summer because the water there is cooler.

11. If some streams in your vicinity are in wooded areas and others in cultivated farm country, you might well take a long walk along several streams in both areas and see the difference in the kind of bottom, or the difference in the depth of the pools If there are rocks on the bottom, carefully remove a few and see if there are insects or crayfish under them.
12. Talk with your local conservation officer. Invite him to

BEST COPY AVAILABLE

BEST COPY AVAILABLE

come to a troop meeting or to the camp to tell you about his work. Often the fish conservationist will be glad to come and talk about his activities, or to show you movies or slides about fish conservation.

13. Learn what the fish laws are for your vicinity, and find out why these regulations were imposed. Remember that they are for your benefit. The person who disobeys these laws is merely harming his own future fishing.
14. Here's an interesting study you might make if you fish on a lake or pond. Get some toy balloons, and some strong, fine thread. When you catch a fish, carefully attach the balloon to the fish with ten feet or more of thread, release it. You will get some information on how the fish moves.